

ASSESSMENT FORM
Explosive Safety

Functional Area: SME	Objective No.: 3	Date: January 2, 2001
----------------------	------------------	-----------------------

OBJECTIVE: Contractor procedures and mechanisms ensure that adequate controls for explosives safety are developed to prevent or mitigate the identified hazards and that the controls are effectively implemented for facilities/activities. Contractor procedures provide assurance that controls will remain in effect so long as the hazards are present. Line managers are responsible for safety; clear roles and responsibilities have been established; and there is a satisfactory level of competence. (CE I-5, CE I-7, CE I-8, CE II-2, CE II-4, CE II-5, CE II-6)

Criteria

1. Contractor procedures are in place for explosives safety that requires adequate controls be developed and put into practice prior to commencing operations or performing work and that the controls remain in effect so long as the hazard is present. Programs adequately consider all hazards that may have an impact on the workers, the public or the environment. Environmental permit limitations are considered.
2. Contractor procedures are in place to provide mechanisms or processes for gaining authorization to conduct operations or perform work involving explosives hazards. Authorization is dependent on satisfactory control of all explosives hazards.
3. Contractor mechanisms are in place and utilized that specify for the control of work involving explosives that line management is responsible for safety.
4. Contractor personnel who plan, control, and conduct work that involve explosives hazards are required to have competence commensurate with the assigned responsibilities.
5. Contractor procedures for explosives safety provide for feedback and improvement.

Approach

Record Review: Review ISMS Description and Facility Safety Plans (FSPs) to ensure that these manuals of practice adequately address explosives safety concerns. Review the applicable portions of the LLNL Health and Safety Manual.

Ensure that the manuals of practice require and that actual practice confirms that: (1) the scope of all work (operations, programmatic, and maintenance) in facilities and activities be defined; (2) that all appropriate hazards (including the impacts of lower-probability accidents) to workers and the public be considered and controls developed, and (3) the process for this discipline is integrated with other safety disciplines. Evaluate the ES&H Teams' safety responsibilities and processes for explosives safety and integration. Evaluate the involvement from workers and explosives safety professionals in the various feedback and improvement activities.

Ensure that appropriate directorate mechanisms, facility/activity procedures, and/or the LLNL ES&H Manual define requirements, verify controls are in place prior to performing work, and verify that these controls will remain in place as long as the hazards are present. Review the selection, training and qualification process to ensure that requirements have been established for those safety specialists within the explosives safety disciplines and that those requirements are appropriate for their responsibilities.

Review a sample of work packages and confirm that adequate consideration was given to explosives safety concerns. Confirm that the scope of production or research-type work is sufficiently narrow that hazards are adequately characterized. Confirm whether processes and practices for identifying the controls ensure that if unexpected conditions arise that have the potential for changing the hazards from those anticipated during the IWS development process, that work will stop. Confirm that the IWS process is sufficiently mature as a process and in practice to appropriately control and authorize work involving explosives safety.

Interviews: Interview selected personnel within the Hazards Control Department, explosives safety specialists on or supporting ES&H Teams, and facility/activity line managers. Through interviews, assess their understanding and support for the safety and health control of activities within the selected facilities. Determine whether ES&H Teams are aware of the environmental permit limitations and consider them when evaluating work planning. Confirm whether those approving the work and controls have an adequate understanding of the potential hazards of the proposed activity and the effectiveness of the identified controls.

Observation: Observe participation of explosives safety personnel in the planning and conduct of work. Observe participation in the walk-down of a job-site. Observe participation in the development of work packages, as available. Observe participation in pre-job briefings as well as any surveillance activities by the explosives safety personnel associated with the specific jobs. Observe participation in the post-job critiques or lessons learned sessions.

Record Review:

- Site 300 Chemistry Area Basis for Interim Operation (BIO), May 2000
- Review Comment Record Site 300 Chemistry Area BIO, 8/9/99
- Chemistry & Materials Science Directorate (C&MS) Integrated Management System (ISMS) Implementation Plan, August 2000
- FSP S300-7, Facility Safety Procedure (FSP) Site 300 Energetic Materials Chemistry Area, March 1, 1999
- C&MS Process Safety Management (PSM) Process Hazard Analysis (PrHA) for the LLNL Site 300 Chemistry Area, March 1997
- C&MS PSM PrHA for the LLNL Site 300 Process Area, March 1997
- Current Status on C&MS PSM PrHA for the LLNL Site 300 Chemistry Area, undated
- UCRL-MA-133867, LLNL ES&H Manual, Volume II, Part 5: Explosives/Firearms, Explosives, Approved 8/11/00
- Integrated Work Sheet (IWS) List for LLNL Site 300 Chemistry Area, August 11, 2000
- ES&H Lessons Learned, LLNL, Improperly Labeled Chemicals Found to be Explosives, May 2, 1994

- ES&H Lessons Learned, LLNL, Be Aware of Precautions for Incompatible Chemicals, January 24, 1996
- ES&H Lessons Learned, LLNL, Use the Right Chemicals, January 25, 1999
- ES&H Lessons Learned, LLNL, Safety Alert, Safely Transporting Pressurized Gas Cylinders Containing Propane Onsite, November 4, 1998
- ES&H Lessons Learned, LLNL, Thoroughly Evaluate the Hazards of Your Work, June 3, 1997
- ES&H Lessons Learned, LLNL, Safety Alert, Rupture Disc Replacement, June 23, 1997
- C&MS Site 300 Facility Walk Through Record, January - March 2000
- C&MS Site 300 Facility Manager Summary of Walk-throughs, April – June 2000
- C&MS Site 300 Facility Manager Summary of Walk-throughs, July - August 2000
- Summary Information for the Chemistry and Chemical Engineering Division of C&MS (CChED), April-June 2000, C&MS AI Walkthroughs
- Management Visit of C&MS Site 300 Facilities, June 22, 2000
- C&MS Site 300 Facility and Operations Management Organization Chart, undated
- Training Records for C&MS Facility Manager for Site 300 Chemistry and Process Areas
- Training Records for C&MS Operations Manager for Site 300 Chemistry and Process Areas
- Training Records for Site 300 C&MS Chemistry Area Supervisor
- Training Records for Site 300 C&MS Chemistry Area Technicians
- Training Records for Site 300 C&MS Chemistry Area Chemist
- Training/Qualification Records for Team 1 and Team 3 Explosives Safety Engineers
- CChED and Site 300 Self Assessment on Compliance with Secondary Containment, July 6, 2000
- CChED and Site 300 Self-Assessment on Emergency Showers and Eye Washes, May 15, 2000
- CChED Self-Assessment on Training, May 8, 2000
- Explosives Storage Inspection of Magazines, April 11, 2000
- Explosives Safety Committee Meeting minutes for 7/27/2000, 6/8/2000, 5/18/2000, 5/4/2000, and 2/24/2000
- IWS 20008, Formulation and Casting of High Explosives, Including Large Charges, 1/28/2000
- IWS 20011, High Explosives Machining, 2/8/2000
- IWS 20015, Machine Tool Repair – High Explosives and Nonexplosives – Mechanical, 2/8/2000
- IWS 20023, Explosives Pressing – Mechanical, 2/14/2000
- IWS 20024, Synthesis of Energetic Materials, 2/15/2000
- Peer Review 851-FY00-064, B Division/Site 300 Explosives Activity Peer Review, Shot P16FP, September 14, 2000
- Peer Review 1384, Casting TNT Parts, 8/27/00
- DOE M 440.1-1, Explosives Safety Manual, w/approved changes through 5/6/97
- UCRL-AR-122036, Site 300 B-Division Firing Areas Safety Analysis Report, September 1997

Interviews Conducted:

- Site 300 Manager
- C&MS Facility Manager for Site 300 Chemistry and Process Areas
- C&MS Operations Manager for Site 300 Chemistry and Process Areas
- ES&H Team 1 Assistant Team Leader, Site 300
- ES&H Team 1 Explosives Safety Professional
- ES&H Team 3 Explosives Safety Professional
- Site 300 Authorizing Individual
- Site 300 C&MS Chemistry Area Supervisor
- Site 300 C&MS Chemistry Area Technician
- Site 300 C&MS Chemistry Area Chemist
- Site 300 Manufacturing and Materials Engineering Division Process Area Senior Explosives Machinist (Matrixed to C&MS)
- Site 300 Manufacturing and Materials Engineering Division Process Area Explosives Machinist (Matrixed to C&MS)
- Site 300 Manufacturing and Materials Engineering Division Process Area Explosives Machinist (Journeyman/Explosives Trainee) (Matrixed to C&MS)
- Site 300 Manufacturing and Materials Engineering Division Technician (Matrixed to B Division)
- Site 300 B Division Technician
- DOE Facility Representative, Site 300

Observations:

- Pour/Cast TNT Targets at B827, 9/13/00
- Bunker 351 Test Shot, 9/15/00

Discussion of Results:

- 1. Contractor procedures are in place for explosives safety that requires adequate controls be developed and put into practice prior to commencing operations or performing work and that the controls remain in effect so long as the hazard is present. Programs adequately consider all hazards that may have an impact on the workers, the public or the environment. Environmental permit limitations are considered.**

With the exception of preparing IWSs before work is performed, the explosives safety program at LLNL is relatively unchanged from the way explosives work was performed before the implementation of ISMS. This is primarily due to the explosives safety program having a strong integrated safety management process of its own. Every element of ISMS has a counterpart within the LLNL explosives safety program that had been implemented years prior to the establishment of the ISMS processes. Initial focus of the explosives safety program is protection of workers unrelated to the work in progress, facilities, the public, and the environment. Due to the hazardous nature of explosives operations, there are many activities in which risk to the worker performing the work must be accepted, although all practical means of mitigating the risks are taken, and every effort is made to protect the worker in question.

As a part of the explosives safety program, hazards are analyzed and controls implemented. Prior to ISMS this was done through several documents. The Explosives Safety chapter of the LLNL ES&H manual provides the means through which the DOE Explosives Safety Manual is implemented by LLNL, and provides the basis for hazards analysis. Facility Safety Procedures (FSPs) generally identify the hazardous activities normally performed within a facility, as well as controls and procedures to be followed in performing those activities. The Basis for Interim Operations (BIOs) addresses the hazards associated with a facility that might affect other facilities, the public, or the environment and, together with the FSPs, provides justification for continued operation (JCO) of the facilities. Operational Safety Procedures (OSPs) address activities that are conducted within the facilities that involved hazards or hazard levels not addressed by the FSPs, or which exceed the limits established by the FSPs.

Finally, a document called a peer review is prepared for each activity and forms the basis for authorizing the activity. The peer review is initiated by the individual responsible for the work request and involves reviews of the proposed work by facility personnel, safety and health professionals, the personnel responsible for performing the work, and other personnel that might have knowledge of similar work. Hazards associated with the proposed work are analyzed, and a determination made if the work falls within the existing boundaries of the FSP, or if the work requires the preparation of an OSP. Prior to ISMS, the peer review was the authorizing document for work performed in the explosives areas. Changes in the manner that the work is performed are documented by the workers on the log sheets accompanying the peer reviews, creating a record for future peer reviews. If the workers feel that a change may affect the safety of the operation, work is stopped and the change discussed with supervision. The peer reviews for each activity are maintained on file indefinitely, and used in the preparation of peer reviews for similar future activities. **(Strength SME3.1)**

In addition to the above analyses, process hazard analyses (PrHAs) were developed in 1997 for all explosives activities in the Site 300 Chemistry and Process areas, as required by the DOE Explosives Safety Manual. The detailed qualitative analyses focused on hazards to the workers, especially as a result of detonation, and identified possible triggering events using the failure modes and effects analysis methodology. A set of recommendations covering activities in both areas was developed, but no corrective action plan or tracking of the recommendations was performed prior to the beginning of this ISMS review. **(Issue SME3.2)** In addition, the personnel performing the work in the Chemistry and Process areas never saw the completed PrHA reports, and were never informed of the status of the recommendations. **(Issue SME3.3)** Based on discussions with ES&H Team I explosives safety professional and a review of the corrective action plan for the C&MS Chemistry and Process area PrHAs, it was determined that no PrHA has been developed for the Site 300 test areas, nor was there any plan to perform a PrHA for those areas. DOE M440.1-1 requires PrHAs for all explosives synthesis, formulation, manufacturing, testing, and disposal operations. DOE M 440.1-1 goes beyond the requirements of 29 CFR 1910.109 and 1910.119 to include testing and disposal operations, thus ensuring consistent, documented hazard analyses for explosives operations. The test areas at Site 300 are covered by a DOE-approved SAR, which meets most, although not all of the requirements for a PrHA. DOE/OAK and LLNL need to determine if this document, together with the applicable FSPs, OSPs, and IWSs, meets the intent of DOE M 440.1-1 for PrHAs. **(Issue SME3.4)**

Upon implementation of ISMS, a new hazard analysis document, the Integration Work Sheet (IWS), was developed for work authorization. Where the peer review is approved at lower management levels, this document is approved within C&MS at the Associate Director Level (the designated authorizing individual). The IWS draws upon existing analyses, and duplicates to some extent the peer reviews. However, the IWS involves senior LLNL management in the analysis and approval process for work, and no work may be performed without the Authorizing Individual's approval of an IWS covering the work. This has caused increased management awareness of the activities and hazards associated with explosives work. Within the Site 300 Chemistry and Process areas, these IWSs are general documents each covering a broad band of activities, e.g., all explosives machining, mechanical pressing of explosives, synthesis of explosives, tool repair, etc.

2. Contractor procedures are in place to provide mechanisms or processes for gaining authorization to conduct operations or perform work involving explosives hazards. Authorization is dependent on satisfactory control of all explosives hazards.

There are two parallel processes to gain authorization to perform work, the Peer Review process and the IWS process. The IWS process results in authorization at a higher management level and is the final authorization to perform work. However, most IWSs reviewed authorize general conduct of operations, while the peer reviews authorize specific projects within the boundaries of the IWS. For activities not covered by existing IWSs, specific IWSs are to be developed. No such specific IWS was reviewed in this evaluation.

Every activity that is performed is covered by a peer review. To some extent, the peer reviews still act as the authorization for specific activities under an IWS. For example, IWS 20008 approves the formulation and casting of high explosives, including large charges, in the Site 300 Chemistry area, where a peer review allows the casting of a specific set of charges (1250 grams TNT) under that IWS. At Site 300, peer reviews include approval of the Site Manager, the C&MS Operations Manager and the Chemistry or Process area supervisors.

3. Contractor mechanisms are in place and utilized that specify for the control of work involving explosives that line management is responsible for safety.

LLNL uses several mechanisms to control explosives work. Procedures are developed in accordance with the DOE Explosives Safety Manual, and become part of the FSP. Peer reviews ensure close coordination and control of work by the requestor, the worker, line management, and safety teams. The direction for these processes flow from both the LLNL Explosives Safety Chapter of the ES&H Manual and the C&MS ISMS Implementation Plan. Work is not permitted without authorization by line management. At Site 300, the work also requires approval of the Site Manager, the C&MS Facilities Manager, and the C&MS Operations Manager.

The ES&H Team 1 Explosives Safety Engineers provide oversight of operations. This oversight is performed both through formal assessments and reviews of IWS and peer review documentation. They also provide explosives safety training as needed, some of which is

documented in LTRAIN. In this manner they act as an additional set of eyes for line and senior management.

Senior management also performs walkthroughs of facilities and (during the approval process for IWSs) specific operations. These are documented as part of their walk-through records and summaries.

4. Contractor personnel who plan, control, and conduct work that involve explosives hazards are required to have competence commensurate with the assigned responsibilities.

There is extensive training provided to personnel who plan, control, and conduct work that involves explosive hazards. Line supervisors have many years of experience in explosives work and are well aware of their safety responsibilities. Each employee receives an annual qualification review. Requirements for additional or recurring training are identified and tracked through LTRAIN. The training requirements for explosives safety have not changed as a result of the LLNL ISMS implementation, with the exception of additional formal training on the ISMS process and on the development of IWSs.

In order to work at Site 300, site-specific training is required for all personnel. In addition, for all personnel, job-specific training is required. This training includes both classroom training and on-the-job (OJT) training. Included in this training are knowledge of all applicable FSPs, OSPs, the Explosives Safety Chapter of the ESH Manual, applicable portions of the Site 300 Safety and Operational Manual, equipment operated by the individual, and other explosives-related operations the individual would be expected to perform during their job. While personnel are receiving OJT training associated with specific task (such as operating a piece of equipment), they are constantly supervised by either their supervisor or a co-worker who is qualified to perform that task. Only after they have been certified by their supervisor to perform the task are they allowed to perform the task alone. Documentation of this certification was found in the employee annual qualification review forms. Even then, there are certain tasks, which require a minimum of two personnel to perform the work. This is documented in the FSP, OSP, and/or IWS. All personnel packaging or transporting explosives are required to attend formal training in addition to OJT on these tasks.

The explosives safety engineers responsible for oversight have more than twenty years explosives experience each. Their training includes site specific training and courses/conferences outside LLNL that ensure their awareness of the latest changes in explosives safety. They are frequently involved in providing training to other LLNL employees, as well as performing reviews of FSPs, OSPs, IWSs and peer reviews of activities.

5. Contractor procedures for explosives safety provide for feedback and improvement.

There are several key avenues through which LLNL personnel involved in explosives provide feedback. One key area is the peer review, as described above. In addition, all personnel are aware of their authority to stop work and, based on the interviews conducted, do not hesitate to

use that authority if the work seems unsafe or the employees are unsure of the work parameters. Other means of feedback include group discussions before and after conducting work, and logs kept during the performance of the jobs. The employees enter any procedural changes or difficulties on conducting the work as written in these logs. These logs are attached to the peer review at completion of the job, and become part of the documentation for future peer reviews. They also discuss the logs with their supervisor and the activity requestor as an informal lessons-learned process. This is another process that pre-dates ISMS.

Conclusion: The Objective has been met.

Strength(s):

- The peer review process involves everyone from the requestor to the worker, including explosives safety oversight, in evaluating a work activity and its associated hazards. It also provides a permanent record of process changes and lessons learned for use in evaluating future activities. **(SME3.1)**

Issue(s):

- Corrective action plans were not developed for recommendations resulting from the 1997 PrHAs for the Site 300 Chemistry and Process areas, and recommendations were not tracked to completion prior to the beginning of the LLNL ISMS Phase II-B evaluation. **(SME3.2)**
- The results of the final Process Hazard Analyses for the Site 300 Chemistry and Process areas, the corrective actions, and status of corrective actions were not communicated to the workers in those areas. **(SME3.3)**
- DOE/OAK and LLNL shall verify if existing hazard analysis documentation for the Site 300 test areas meets the requirements for a process hazard analysis. **(SME3.4)**

Team Member: _____ Julian Biggers	Team Leader: _____ James Winter
--------------------------------------	------------------------------------